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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/575,401	04/10/2006	Kazuo Hara	NNA-111-B	3767

48980 7590 11/09/2009

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EXAMINER	
LICHTI, MATTHEW L	

ART UNIT	PAPER NUMBER
3663	

NOTIFICATION DATE	DELIVERY MODE
11/09/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/575,401	Applicant(s) HARA ET AL.	
	Examiner Matthew Lichti	Art Unit 3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09/03/2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 09/03/2009 has been entered.

Response to Arguments/Amendments

2. Applicant's argues that the cited references fail to teach or suggest a value of a control signal used to apply a steering reaction force to the steering wheel equal to a summation of a plurality of terms including a steering angle term, a steering velocity term, and a steering acceleration term and a controller configured to reduce the steering reaction force applied if the hands-off state is indicated relative to the steering reaction force applied if the hands-on state is indicated by using a different value of at least one of a coefficient and a gain for at least one of the plurality of terms.

However, Kato et al. teaches a value of the reaction force control signal equal to summations of a plurality of terms in the figures in steps S24, S40, and S68. The terms in the summations are based on steering angle, velocity, and acceleration terms. Col. 11, lines 6-19 states that the reaction force is reduced. While the exact summation is not used by Kato, it would be obvious to use all of the terms in one summation and

reduce any or all of them in order to reduce the reaction force when hands-off is detected. Figure 4C of Serizawa shows the summation equation using gains M0, M1, and M2 for steering angle, velocity, and acceleration.

Kato et al. teaches in figures 2 through 10 the formula for calculating the reaction force. A summation used in a hands-on state is shown in figure 5, and a summations used in hands-off state are shown in figures 4, 7, and 10. It is clear from the figures that many coefficients and gains (T, I, K, P, D, H, V, J) vary based on whether hand-off state is detected. The figures also teach using steering angle, velocity, and acceleration as explained below. .

a. When hands-free state is detected, Kato teaches using steering angle θ_M and θ_S in steps S14 and S16 of figure 4, step 56 of figure 7, and step S74 of figure 10. Kato also teaches steering angular velocity $d\theta_M$ and $d\theta_S$ in step s58 and s60 of figure 7. The proportional element of step s66 is in effect a steering acceleration term because it takes a difference in steering velocity between two cycles which would be a change in steering velocity with respect to time.

- From step S66, the proportional element P_n equals $(\Delta H_n - \Delta H_{n-1})*K_{p3}$,
- By substituting from s62, P_n equals $((d\theta_{Mn} - d\theta_{Mn-1}) - (d\theta_{Sn} - d\theta_{Sn-1}))*K_{p3}$
- This means P_n is proportional to $dd\theta_M - dd\theta_S$, the difference between the measured and actual angular accelerations (col. 9, lines 40-47)

b. When the hands free-state is not detected, the control signal is based on a steering angle term θ_S (col. 8, lines 1-9, figure 5, step s30, T_M is based on θ_S). In step S36, it is multiplied by a gain KI2. Since Kato et al. do not particularly

disclose using steering angular velocity and steering angular acceleration when hands-free state is not detected, the coefficients for these terms can be considered to be set to zero when hand-free state is not detected.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims **1, 3, 6, 7, 9, 12-14, 16**, **19, 20, and 22** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kato et al. (U.S. 6,082,482) by Kato et al. in view of in view of Serizawa et al. (U.S. 5,347,458).

5. Regarding claim 1, Kato et al. disclose a steering control device for use in a vehicle having a steering wheel that receives steering input, and an electronically-controlled steering unit that turns the vehicle's wheels over a road surface based on the position of the steering wheel, comprising:

a reaction force device (fig. 1, reaction force actuator 3) coupled to the steering wheel (2) and responsive to a control signal (reaction force torque signal from steering control unit 4) to apply a steering reaction force to the steering wheel (col. 6, lines 7-13);

a hands-free sensor (fig. 1, steering control unit 4, vehicle speed sensor 6, torque sensor 32) adapted to generate a signal indicative of whether the steering wheel is in a hands-on state or a hands-off state (fig. 3, col. 7, lines 15-29; col. 5, lines 27-29); and

a controller (steering control unit 4, reaction force inhibitor, col. 5, lines 29-31) adapted to vary the control signal in response to the hands-free sensor signal to reduce the steering reaction force applied when the hands-off state is indicated relative to the steering reaction force applied when the hands-on state is indicated (fig. 4, signal varied to reduce reaction force, col. 7, lines 11-14; fig. 10, col. 11, lines 1-11).

Kato et al. further teaches in figures 2 through 10 summations for calculating the reaction force. The summations used in a hands-on state are shown in figure 5, and the parts of the summations used in hands-off state are shown in figures 4, 7, and 10. The figures also teach using steering angle Kp* θ, velocity kd*dθ/dt, and acceleration kdd*d^2θ/dt. When hands-free state is detected, Kato teaches using steering angle θ_M and θ_S in steps S14 and S16 of figure 4, step 56 of figure 7, and step S74 of figure 10. Kato also teaches steering angular velocity $d\theta_M$ and $d\theta_S$ in step s58 and s60 of figure 7. The proportional element of step s66 is in effect a steering acceleration term because it takes a difference in steering velocity between two cycles which would be a change in steering velocity with respect to time.

- From step S66, the proportional element P_n equals $(\Delta H_n - \Delta H_{n-1})*K_{p3}$,
- By substituting from s62, P_n equals $((d\theta_{Mn} - d\theta_{Mn-1}) - (d\theta_{Sn} - d\theta_{Sn-1}))*K_{p3}$
- This means P_n is proportional to $dd\theta_M - dd\theta_S$, the difference between the measured and actual angular accelerations (col. 9, lines 40-47)

When the hands free-state is not detected, the control signal is based on a steering angle term θ_S (col. 8, lines 1-9, figure 5, step s30, T_M is based on θ_S). Since Kato et al. do not specifically teach using steering angular velocity and acceleration when hands-

free state is not detected, the coefficients for these terms can be considered to be set to zero when hand-free state is not detected.

However, Kato et al. do not specifically disclose a summation formula that uses a steering angle, steering velocity, and steering acceleration terms.

Serizawa et al. teach a steer by sire system with steering angle velocity and acceleration detection sensors adapted to generate a signal indicative of the steering angle velocity and acceleration (steering angle obtained from potentiometers 3 and 4 and encoder 5, col. 5, lines 2-3, derivatives taken, col. 5, lines 21-26); wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle velocity and acceleration (col. 7, lines 8-18). Figure 4C of Serizawa shows the summation equation using gains M0, M1, and M2 for steering angle, velocity, and acceleration.

It would have been obvious to one of ordinary skill in the art at the time the invention was for the system of Kato et al. to include using steering angle, steering angle velocity, and steering angle acceleration to calculate the reaction force as taught by Serizawa et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and steering velocity and acceleration effects the feeling of steering a mechanically coupled steering wheel. Since steering angle velocity & acceleration are used in the Kato's hands off state embodiment of figure 7, it would be obvious to use these terms in the hands-on state as well to simplify the formula, such as in the embodiment of figure 10, (col. 3, lines 51-54).

6. Regarding claims 7 and 22, Kato et al. disclose a vehicle having road wheels (fig. 1, wheels 10), comprising:

a steering unit (steering wheel 2);

an electronically-controlled turning unit (steering motor 5) responsive to the steering unit (2) which turns the road wheels based on the position of the steering unit (col. 5, lines 22-27) ;

a steering reaction force applicator (3) adapted for applying a steering reaction force to the steering unit (col. 5, lines 21-22);

a hands-free sensor (fig. 1, steering control unit 4, vehicle speed sensor 6, torque sensor 32) adapted for detecting whether the steering unit is in a hands-off state or a hands-on state (fig. 3, col. 7, lines 15-29; col. 5, lines 27-29); and

a steering reaction force correction component (reaction force inhibitor, col. 5, lines 29-31) adapted for reducing the steering reaction force applied when the hands-off state is detected relative to the steering reaction force applied when the hands-on state is detected (fig. 4, reaction force R8 reduced to if R4 is YES, col. 7, lines 11-14).

Kato et al. further teaches in figures 2 through 10 summations for calculating the reaction force. The summations used in a hands-on state are shown in figure 5, and the parts of the summations used in hands-off state are shown in figures 4, 7, and 10. The figures also teach using steering angle Kp* θ, velocity kd*dθ/dt, and acceleration kdd*d^2θ/dt. When hands-free state is detected, Kato teaches using steering angle θ_M and θ_S in steps S14 and S16 of figure 4, step 56 of figure 7, and step S74 of figure 10. Kato also teaches steering angular velocity $d\theta_M$ and $d\theta_S$ in step s58 and s60 of figure 7.

The proportional element of step s66 is in effect a steering acceleration term because it takes a difference in steering velocity between two cycles which would be a change in steering velocity with respect to time.

- From step S66, the proportional element P_n equals $(\Delta H_n - \Delta H_{n-1})*K_{p3}$,
- By substituting from s62, P_n equals $((d\theta_{Mn} - d\theta_{Mn-1}) - (d\theta_{Sn} - d\theta_{Sn-1}))*K_{p3}$
- This means P_n is proportional to $dd\theta_M - dd\theta_S$, the difference between the measured and actual angular accelerations (col. 9, lines 40-47)

When the hands free-state is not detected, the control signal is based on a steering angle term θ_S (col. 8, lines 1-9, figure 5, step s30, T_M is based on θ_S). Since Kato et al. do not specifically teach using steering angular velocity and acceleration when hands-free state is not detected, the coefficients for these terms can be considered to be set to zero when hand-free state is not detected.

However, Kato et al. do not specifically disclose a summation formula that uses a steering angle, steering velocity, and steering acceleration terms.

Serizawa et al. teach a steer by sire system with steering angle velocity and acceleration detection sensors adapted to generate a signal indicative of the steering angle velocity and acceleration (steering angle obtained from potentiometers 3 and 4 and encoder 5, col. 5, lines 2-3, derivatives taken, col. 5, lines 21-26); wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle velocity and acceleration (col. 7, lines 8-18). Figure 4C of Serizawa shows the summation equation using gains/coefficients M0, M1, and M2 for steering angle, velocity, and acceleration.

It would have been obvious to one of ordinary skill in the art at the time the invention was for the system of Kato et al. to include using steering angle, steering angle velocity, and steering angle acceleration to calculate the reaction force as taught by Serizawa et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and steering velocity and acceleration effects the feeling of steering a mechanically coupled steering wheel. Since steering angle velocity & acceleration are used in the Kato's hands off state embodiment of figure 7, it would be obvious to use these terms in the hands-on state as well to simplify the formula, such as in the embodiment of figure 10, (col. 3, lines 51-54).

7. Regarding claim 13, Kato et al. disclose a vehicle (fig. 1) for controlling road wheels (10) of the vehicle comprising:

means (motor 5) for turning the road wheels (10) in response to a steering input of a steering unit (steering wheel 5, col. 5, lines 22-27);

means (reaction force actuator 3) for applying a steering reaction force to the steering unit (col. 5, lines 21-22);

means (fig. 1, steering control unit 4, vehicle speed sensor 6, torque sensor 32) for detecting whether the steering unit is in a hands-on or hands-off state (fig. 3, col. 7, lines 15-29; col. 5, lines 27-29); and

means (reaction force inhibitor, col. 5, lines 29-31) for reducing the steering reaction force in the hands-on state when the hands-off state is detected (fig. 4, reaction force reduced in hands-off state, col. 7, lines 11-14).

Kato et al. further teaches in figures 2 through 10 summations for calculating the reaction force. The summations used in a hands-on state are shown in figure 5, and the parts of the summations used in hands-off state are shown in figures 4, 7, and 10. The figures also teach using steering angle Kp* θ, velocity kd*dθ/dt, and acceleration kdd*d^2θ/dt. When hands-free state is detected, Kato teaches using steering angle θ_M and θ_S in steps S14 and S16 of figure 4, step 56 of figure 7, and step S74 of figure 10. Kato also teaches steering angular velocity $d\theta_M$ and $d\theta_S$ in step s58 and s60 of figure 7. The proportional element of step s66 is in effect a steering acceleration term because it takes a difference in steering velocity between two cycles which would be a change in steering velocity with respect to time.

- From step S66, the proportional element P_n equals $(\Delta H_n - \Delta H_{n-1})*K_{p3}$,
- By substituting from s62, P_n equals $((d\theta_{Mn} - d\theta_{Mn-1}) - (d\theta_{Sn} - d\theta_{Sn-1}))*K_{p3}$
- This means P_n is proportional to $dd\theta_M - dd\theta_S$, the difference between the measured and actual angular accelerations (col. 9, lines 40-47)

When the hands free-state is not detected, the control signal is based on a steering angle term θ_S (col. 8, lines 1-9, figure 5, step s30, T_M is based on θ_S). Since Kato et al. do not specifically teach using steering angular velocity and acceleration when hands-free state is not detected, the coefficients for these terms can be considered to be set to zero when hand-free state is not detected.

However, Kato et al. do not specifically disclose a summation formula that uses a steering angle, steering velocity, and steering acceleration terms.

Serizawa et al. teach a steer by sire system with steering angle velocity and acceleration detection sensors adapted to generate a signal indicative of the steering angle velocity and acceleration (steering angle obtained from potentiometers 3 and 4 and encoder 5, col. 5, lines 2-3, derivatives taken, col. 5, lines 21-26); wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle velocity and acceleration (col. 7, lines 8-18). Figure 4C of Serizawa shows the summation equation using gains M0, M1, and M2 for steering angle, velocity, and acceleration.

It would have been obvious to one of ordinary skill in the art at the time the invention was for the system of Kato et al. to include using steering angle, steering angle velocity, and steering angle acceleration to calculate the reaction force as taught by Serizawa et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and steering velocity and acceleration effects the feeling of steering a mechanically coupled steering wheel. Since steering angle velocity & acceleration are used in the Kato's hands off state embodiment of figure 7, it would be obvious to use these terms in the hands-on state as well to simplify the formula, such as in the embodiment of figure 10, (col. 3, lines 51-54).

8. Regarding claim 14, Kato et al. disclose a method for controlling the road wheels of a vehicle comprising:

turning the road wheels from a steering input via a steering unit (col. 5, lines 22-27);

applying a steering reaction force to the steering unit (col. 5, lines 21-22);

detecting whether the steering unit is in a hands-on or hands-off state (fig. 3, col. 7, lines 15-29; col. 5, lines 27-29); and

reducing the steering reaction force applied when the hands-off state is detected relative to the steering reaction force applied when the hands-on state is detected (col. 5, lines 29-31, fig. 4, reaction force reduced if hands-off detected, col. 7, lines 11-14).

Kato et al. further teaches in figures 2 through 10 summations for calculating the reaction force. The summations used in a hands-on state are shown in figure 5, and the parts of the summations used in hands-off state are shown in figures 4, 7, and 10. The figures also teach using steering angle Kp* θ, velocity kd*dθ/dt, and acceleration kdd*d^2θ/dt. When hands-free state is detected, Kato teaches using steering angle θ_M and θ_S in steps S14 and S16 of figure 4, step 56 of figure 7, and step S74 of figure 10. Kato also teaches steering angular velocity $d\theta_M$ and $d\theta_S$ in step s58 and s60 of figure 7. The proportional element of step s66 is in effect a steering acceleration term because it takes a difference in steering velocity between two cycles which would be a change in steering velocity with respect to time.

- From step S66, the proportional element P_n equals $(\Delta H_n - \Delta H_{n-1})*K_{p3}$,
- By substituting from s62, P_n equals $((d\theta_{Mn} - d\theta_{Mn-1}) - (d\theta_{Sn} - d\theta_{Sn-1}))*K_{p3}$
- This means P_n is proportional to $dd\theta_M - dd\theta_S$, the difference between the measured and actual angular accelerations (col. 9, lines 40-47)

When the hands free-state is not detected, the control signal is based on a steering angle term θ_S (col. 8, lines 1-9, figure 5, step s30, T_M is based on θ_S). Since Kato et al.

do not specifically teach using steering angular velocity and acceleration when hands-free state is not detected, the coefficients for these terms can be considered to be set to zero when hand-free state is not detected.

However, Kato et al. do not specifically disclose a summation formula that uses a steering angle, steering velocity, and steering acceleration terms.

Serizawa et al. teach a steer by sire system with steering angle velocity and acceleration detection sensors adapted to generate a signal indicative of the steering angle velocity and acceleration (steering angle obtained from potentiometers 3 and 4 and encoder 5, col. 5, lines 2-3, derivatives taken, col. 5, lines 21-26); wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle velocity and acceleration (col. 7, lines 8-18). Figure 4C of Serizawa shows the summation equation using gains M0, M1, and M2 for steering angle, velocity, and acceleration.

It would have been obvious to one of ordinary skill in the art at the time the invention was for the system of Kato et al. to include using steering angle, steering angle velocity, and steering angle acceleration to calculate the reaction force as taught by Serizawa et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and steering velocity and acceleration effects the feeling of steering a mechanically coupled steering wheel. Since steering angle velocity & acceleration are used in the Kato's hands off state embodiment of figure 7, it would be obvious to use these terms in the hands-on state as well to simplify the formula, such as in the embodiment of figure 10, (col. 3, lines 51-54).

9. Regarding claims 3, 9, and 16, Kato et al. teach using a different gain/coefficient for steering angle in hands-off state than when hands off state is not detected (in hands-on, a table is used from steering angle, col. 8, lines 1-9; different coefficients used in the hands on embodiments of figure 4 which uses KI). The embodiment of figure 10 teaches reducing the reaction force in the hands-off state which would reduce the the reaction force corresponding to steering angle (col. 11, lines 1-10)

10. Regarding claims 4, 5, 10, 11, 17, and 18 Kato et al. disclose steering velocity and acceleration gains in the hands-off state (figure 7, velocity gain KI3 in step s64, acceleration gain Kp3 in step s66) and reducing all components of the reaction force in hands-off state from the reaction force used in the hands-on state (col. 11, lines 1-10). However Kato et al. do not particularly disclose reducing the reaction force corresponding to steering velocity/acceleration.

Serizawa et al. teach a steer by sire system with steering angle velocity and acceleration detection sensors adapted to generate a signal indicative of the steering angle velocity and acceleration (steering angle obtained from potentiometers 3 and 4 and encoder 5, col. 5, lines 2-3, derivatives taken, col. 5, lines 21-26); wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle velocity and acceleration (col. 7, lines 8-18, fig. 4c);

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the steer-by-wire system of Kato et al. to include using steering angle velocity and/or steering angle acceleration to calculate the reaction force

as taught by S et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and steering velocity and acceleration effects the feeling of steering a mechanically coupled steering wheel. It would be obvious to use with the embodiment of figure 10 of Kato where all components of the reaction force are reduced.

11. Regarding claims 6, 12, and 19, Kato et al. disclose a steering torque detection sensor (torque sensor 32) adapted to generate a signal indicative of steering torque (figure 3, step S6); and wherein the controller is further adapted to vary the reaction force when the indicated steering torque decreases (col. 7, lines 11-14, col. 11, lines 3-8).

12. Regarding claim 20, Kato et al. disclose reducing the reaction force when steering torque decreases (fig. 3, hands-off state detected based on steering torque, reaction force reduced based on steering torque). Kato et al. do not particularly teach that coefficients for steering angle, steering angle velocity, and steering angle acceleration terms depend on steering torque. It would have been obvious to reduce any or all coefficients in order to reduce reaction force when steering torque indicates a hands-off state.

13. Claims **2, 8, 15, 21, and 23-25** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kato et al. (U.S. 6,082,482) in view of Serizawa et al. (U.S. 5,347,458) and Higashira et al. (U.S. 5,908,457).

14. Regarding claims 2, 8, and 15, Kato considers the road surface (col. 2, lines 22-32) in the reaction torque which is based on replicating the steering feel of a

mechanically connected steering wheel in a hands on state (col. 1, lines 49-67) but only applies torque to return to neutral in a hands off state (col. 2, lines 11-21). The term "indicative of road surface reaction force" is very broad, and does not require any specific sensors. The steering angle and steering torque signals used to determine reaction force in the hands-on state (Kato, figure 5, col. 8, lines 1-14) can be indicative of a road surface reaction force, and the coefficients are different in the hands-off state of figures 4, 7, and 10. However, Kato do not particularly disclose reducing a road surface reaction torque coefficient or gain.

Higashira et al. teach steer-by-wire system with a road surface reaction force sensor adapted to generate a signal indicative of road surface reaction force (fig. 1, sensors 7b, 7c, & 7d determine the friction coefficient of the road surface), wherein the reaction force device is further adapted to apply the steering reaction force corresponding to the indicated road surface reaction force (col. 9, lines 44-57).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the steer-by-wire system that reduces reaction force when a hands off state is detected of Kato et al. to include using a using road surface friction to calculate the reaction force as taught by Higashira et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and the road surface friction effects the feeling of steering a mechanically coupled steering wheel. Since the purpose of the road surface reaction force is to recreate the feel, it would be obvious to reduce or eliminate in a hands-off state.

15. Regarding claims 21, 23, and 24, Kato considers the road surface (col. 2, lines 22-32) in the reaction torque which is based on replicating the steering feel of a mechanically connected steering wheel in a hands on state (col. 1, lines 49-67) but only applies torque to return to neutral in a hands off state (col. 2, lines 11-21). The term "indicative of road surface reaction force" is very broad, and does not require any specific sensors. The steering angle and steering torque signals used to determine reaction force in the hands-on state (Kato, figure 5, col. 8, lines 1-14) can be indicative of a road surface reaction force, and the coefficients are different in the hands-off state of figures 4, 7, and 10. However, Kato do not particularly disclose a road surface reaction torque coefficient or gain.

Higashira et al. teach steer-by-wire system with a road surface reaction force sensor adapted to generate a signal indicative of road surface reaction force (fig. 1, sensors 7b, 7c, & 7d determine the friction coefficient of the road surface), wherein the reaction force device is further adapted to apply the steering reaction force corresponding to the indicated road surface reaction force (col. 9, lines 44-57).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the steer-by-wire system of Kato et al. to include using a using road surface friction to calculate the reaction force as taught by Higashira et al. because the reaction force is supposed to replicate the feeling of a mechanically coupled steering wheel and the road surface friction effects the feeling of steering a mechanically coupled steering wheel.

16. Regarding claim 25, Kato et al. disclose reducing the reaction force when steering torque decreases (fig. 3, hands-off state detected based on steering torque, reaction force reduced based on steering torque). Kato et al. do not particularly teach that coefficients for steering angle, steering angle velocity, steering angle acceleration, and road surface reaction force terms depend on steering torque. It would have been obvious to reduce any or all coefficients in order to reduce reaction force when steering torque indicates a hands-off state.

Conclusion

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew Lichti whose telephone number is (571) 270-5374. The examiner can normally be reached on Monday - Friday 8:30 AM - 5:30 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack Keith can be reached on (571)272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/M. L./
Examiner, Art Unit 3663

/Jack W. Keith/

Supervisory Patent Examiner, Art Unit 3663